

Logarithms in Practice

While working in a group make sure you:

- Expect to make mistakes but be sure to reflect/learn from them!
 - Are civil and are aware of your impact on others.
 - Assume and engage with the strongest argument while assuming best intent.
1. How many years will it take \$5,500 to amount to \$8,000 if it is invested at an annual rate of 9% compounded monthly?

2. How many years will it take \$5,500 to amount to \$8,000 if it is invested at an annual rate of 9% compounded continuously?

3. *Exponential Growth Model*(§3.1): A population that experiences exponential growth increases according to the model Pe^{rt} where P is the initial population, r is the relative rate of growth, and t is time.

Zombies! The population of zombies is 2 on Wednesday and 5 a day later.

- (a) If the population continues to grow exponentially, how many zombies will there be in a week? 1

- (b) How long until the population of UW Tacoma is gone?
(note: UW Tacoma has about 5000 students)

4. *Radioactive Decay Model:* If P is the initial mass of a radioactive substance with a half life h , then the mass remaining A , at time t is modeled by:

$$A = Pe^{-rt}$$

where $r = \frac{\ln 2}{h}$.

A skeleton of a cat was found in a well and has a ratio of carbon 14 to carbon 12 that is 61% of the corresponding ratio for living things. (Carbon 14 is only made by living things, carbon 14 begins to decay to carbon 12 upon death. The half-life of carbon 14 is 5730 years.) About how long ago did the cat die?

5. *Newton's Law of Cooling:* If D is the initial temperature difference between an object and its surroundings, and if its surroundings have a temperature T , then the temperature of the object A and time t is modeled by:

$$A = T + De^{-kt}$$

where k is a positive constant that depends on the type of object.

Initially coffee has a temperature of 200°F in a room that is 70°. After ten minutes the temperature is 150°. What will the temperature of the coffee be after an additional ten minutes passes?

pH Scales: Let $[H^+]$ be the concentration of hydrogen ions in solution X measured in moles per liter (denoted M). Then

$$\text{pH level of solution } X = -\log[H^+]$$

6. What is the $[H^+]$ of stomach acid if the pH value of stomach acid is 2.3?

7. How many more times concentrated is the stomach acid $[H^+]$ to vinegar's concentration where vinegar commonly has a pH value of 3?

Richter Scale: Let I be the intensity of an earthquake X and S be the intensity of a 'standard' earthquake. Then the measurement of an earthquake X as measured on the Richter Scale is:

$$\log\left(\frac{I}{S}\right)$$

8. In March of 2011 Japan's earthquake was 9.0 on the Richter Scale. February 2001 Tacoma had an earthquake measuring 6.8 on the Richter Scale. How many more times more intense was Japan's earthquake to the one in Tacoma?

Decibels: The loudness of a sound is measured in decibels and is related to the intensity I by

$$10 \log \left(\frac{I}{S} \right)$$

where $S = 10^{-12} \text{ W/m}^2$

9. France passed a law limiting iPods and other MP3 players to a maximum possible volume of 100 decibels. Find the maximum intensity (in W/m^2) an iPod is legally allowed to output in France.